

Copd with cognitive status in an elderly sample



COPD with Cognitive Status in an Elderly Sample using the Third National Health and Nutrition Examination Survey

Dean Sherzai, MD MAS PhD(c), Rachel Schade, Sonia Vega, Ayesha Z.

Sherzai, MD

Author's Affiliations: ¹ Department of Neurology and Neurological Sciences, Cedar Sinai Health System, Los Angeles, CA, USA; ² Keck Science Department, Pitzer College, Claremont, CA, USA; ³ Department of Epidemiology and Biostatistics, Loma Linda School of Public Health, Loma Linda, USA; Department of Neurology, The Neurological Institute of New York, Columbia University Medical Center, New York, New York, USA.

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Abstract

Purpose: Chronic Obstructive Pulmonary Disease (COPD) has been associated with dementia and cognitive impairment. We attempted to assess the relationship between COPD and cognitive impairment in a nationwide database, the National Health and Nutrition Examination Survey (NHANES III).

Methods: Data was analyzed from the NHANES III database, a nationally representative cross sectional observational study among older adults. The diagnosis of COPD was based on calculation of FEV1/FVC ratio, with a cutoff of 0.7. The odds of having poor cognitive status was assessed using logistic regression models between COPD and three cognitive tests (immediate

recall, delayed recall, and serial subtraction tests), adjusted for demographic variables and medical comorbidities.

Results: We identified 17, 181, 182 individuals with a diagnosis of COPD. The mean age of was 71.5 ± 0.19 years. In the crude model, there was a strong relationship between those with COPD and poor cognitive test scores. This relationship was strengthened in the multivariate model adjusted for demographic variables and vascular comorbidities, such that those with COPD had a higher odds of having impaired immediate recall (OR 2.56, 95% CI 1.44- 4.53), delayed recall (OR 3.10, 95% CI 1.73- 5.52), and serial subtraction tests scores (OR 2.74, 95% CI 1.17- 6.40).

Conclusions: Individuals with COPD have a higher odds of having cognitive impairment in this large nationally representative database.

Introduction

Approximately 35.6 million currently suffer from dementia worldwide, and this number is expected to double by 2030 and triple by 2050 [1]. In the last few years we have become more cognizant of the importance of identifying cognitive decline at the earlier stages when it is more amenable to treatment. We have also become more knowledgeable about possible comorbidities that may propagate the process of cognitive decline and ultimate dementia.

Causes of cognitive decline, and possible progression to dementia, are believed to be multifactorial. Chronic Obstructive Pulmonary Disease (COPD) is a progressive disease that affects more than 13.5 million people in the

United States and has been associated with cognitive decline [2]. To date, there are no definitive treatments for dementia; therefore, much emphasis had been placed on the prevention of dementia, and identification of modifiable risk factors early in the disease process. Multiple studies have reported the association between COPD and either global cognitive deficits with the most severe deficiencies in specific cognitive domains such as perception, motor function or memory [3]. Despite the current body of evidence, the majority of studies are based on a single region, and there are a few studies that used a nationally representative data (Health and Retirement Study). Given that society is facing an increase in the rate of chronic diseases of aging [4], and the lack of large scale investigation on the relationship between COPD and diminished cognitive status, we analyzed this nationwide database, the National Health and Nutrition Examination Survey (NHANES III), to better elucidate this relationship.

Materials and Methods

NHANES III is a cross sectional health survey conducted by the National Center for Health Statistics (NCHS), performed from 1988 to 1994 in persons aged two months and older in the United States. NHANES has a multistage, probability sampling design used to select participants representative of the civilian, non-institutionalized US population. Our study population consisted of 39, 488, 973 adults 60 to 89 years. Of these, participants were included if they had measurements for spirometry and the cognitive tests. Based on The Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) standards, cases of COPD were defined based on the patient's ratio of forced expiratory volume (FEV1) to the forced vital capacity (FVC). Patients with a

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ratio of less than 0.7 were classified with COPD. Our control group, patients without COPD, was classified by a ratio greater than 0.7. For the older population, NHANES-III measures cognitive status with three cognitive tests: an immediate and delayed logical verbal memory test from the East Boston Memory Test, a three word registration/memory task (“apple,” “table” and “penny”) and five serial subtractions by intervals of three. A point was awarded for every correct answer from the three word memory task and the logical verbal memory test. For immediate memory, using a summary score of logical memory (0-6 points) plus three word task (0-3 points), we considered less than 5 out of 9 points to be impaired (low), such that individuals with 0-4 were score ‘low’, and those scoring 5-9 were scored ‘high’. For delayed memory, a summary score of less than 4 out of 9 points was considered impaired (low). Both summary scores are consistent with previous NHANES-III reports. For the test of serial subtractions, any miscalculation during the five trials was considered impaired, and only a perfect score was considered ‘high’.

The reported race and ethnicity includes non-Hispanic Whites, non-Hispanic Blacks, Mexican-Americans and ‘other’. Smoking was defined by a “yes” response to the following two questions: “Have you smoked at least 100 cigarettes during your entire life” and “Do you smoke cigarettes now”. These questions can be found on the NHANES III household adult questionnaire. Education was stratified in three categories: < 12 years (less than high school education), high school graduate and > 12 (some college and beyond).

We performed an X^2 and t-test analysis to compare demographic characteristics between patients with COPD and patients without COPD. To assess the association between COPD and a low cognitive test score (with high score as reference) crude and adjusted logistic regression analysis were performed. Adjusted potential confounders were age, race-ethnicity, sex, BMI, education status and smoking. Appropriate NHANES-III weighted sampling was applied during this analysis. All data analyses were conducted using SAS (v 9. 3; SAS Institute Inc., Cary, NC).

Results

Table 1 presents the demographics of the population. There were 17, 181, 182 individuals with COPD; 50. 1% were females, 49. 9% males and 85. 9% were non-Hispanic White. The mean age for patients with COPD was $71. 5 \pm 0. 19$. In both groups, patients had less than a high school education, were non-smokers and had both hospital and medical coverage. Majority of individuals with COPD scored low on each cognitive test as compared to those without COPD (Table 1). Coronary artery disease was the most prevalent comorbidity in patients with COPD (31. 9%) and in patients without COPD (30. 4%).

In the unadjusted model, participants with COPD had increased odds of impaired scores on each of the three cognitive tests: the immediate recall (OR 2. 18, 95% CI 1. 81- 2. 62), delayed recall (OR 2. 25, 95% CI 1. 87- 2. 70) and serial subtraction test (OR 1. 44, 95% CI 1. 10-1. 90).

We then examined the association between COPD and the cognitive tests, initially adjusted by age and race, which diminished the relationship slightly for all three tests, but the relationship was rendered insignificant for the <https://assignbuster.com/copd-with-cognitive-status-in-an-elderly-sample/>

serial subtraction test (OR 1.29, 95% CI 0.95-1.69) (Table 2). Then, we adjusted for age, sex, height, body mass index and education, which did not change the relationship significantly. In the third model, further adjustment for race, poverty income ratio, and medical coverage did not appreciably change the relationship. In the last model, we additionally adjusted for vascular risk factors such as smoking, stroke, hypertension, CHF, diabetes and coronary artery disease. This increased the odds for poor scores for all three tests; immediate recall (OR 2.56, 95% CI 1.44- 4.53), delayed recall test (OR 3.10, 95% CI 1.73- 5.52), and serial subtraction (OR 2.74, 95% CI 1.17- 6.40).

Discussion

We were able to identify a strong association between COPD and diminished cognitive status across three common cognitive tests. Individuals with COPD had significantly greater odds of impaired verbal memory, and this relationship remained robust after adjusting for potential sociodemographic and vascular risk factors. The relationship between COPD and the serial subtraction test scores was rendered significant after it was adjusted for vascular risk factors. Despite evidence in the extant literature showing an association between race with cognitive status [10], race was not a factor in the relationship between COPD and cognitive status.

Our results are consistent with a growing body of evidence that has revealed a strong association between COPD and poor cognitive function. In one of the largest epidemiological studies, The Health and Retirement Study (n= 4,150), patients with severe and non-severe COPD had significantly lower

cognitive test scores compared to healthy controls. In adjusted models, only patients with severe COPD had the lower scores on the cognitive tests [5]. Furthermore, a dose-response relationship between COPD severity and cognitive dysfunction was previously established, with more severe COPD cases performing worse on the cognitive tests [6]. Notably, a 2013 study demonstrated significantly reduced memory tests scores on the Mini Mental State Exam (MMSE) among patients with COPD but without hypoxemia [7]. Further evidentiary support for global cognitive impairment in patients with COPD was also shown in a study that observed significant differences in executive functioning, working memory, episodic memory, processing speed, and visuospatial ability [8]. Recently, several COPD studies have combined cognitive testing with neuroimaging, which have revealed significant white matter pathology in this population, with varying degrees of cognitive impairment [8, 9, 10, 11].

The mechanism by which COPD causes cognitive decline is not very clear. COPD results in hypoxemia and hypercapnia, which has been implicated in diminished cognitive status [3, 5]. Recent imaging studies have pointed to possible microvascular damage [3], and other studies have implicated chronic inflammatory process causing cognitive decline [12]. Yet others believe that the hypoxic process may cause direct neuronal damage, glial activation and the generation of free radicals which could affect cognitive functioning [13]. Given the prevalence of both COPD and cognitive decline in the elderly population and a probable causal relationship, it is important to further investigate the mechanism underlying the relationship.

Limitations

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As all studies, this one has many limitations that need to be visited. One of the limitations unique to our study was that majority of the individuals in our elderly NHANES population had less than high school education. Given that educations has repeatedly been found to be strongly correlated with resilient cognitive function as well as less susceptible to neurodegeneration, our results could have been confounded by the lower mean education level in our population[14-18]. Another limitation lies with the cognitive testing used by NHANES. Only three cognitive tests were utilized, which does not provide a comprehensive assessment of cognitive function. In addition, the cognitive tests used most likely overlap in the cognitive function they measure, not allowing for specificity. However, the cognitive variables have been validated as a good tool for testing memory [19]. Furthermore, the cross-sectional nature of this paper does not allow us to make a causal link. In addition, the restricted scope of lifelong socioeconomic status is a limitation, which is strongly associated with both cognitive impairment and COPD. However, it has been demonstrated that individuals with poor socioeconomic status may have a higher risk of developing COPD and lower cognitive reserve [20, 21]. The strengths of this study are its large, diverse representative sample, that provided extensive medical history and allowed for control of confounding variables, as well as the objective measure of cognitive impairment and COPD. Also, the spirometry data from NHANES III allowed for more accurate diagnosis of COPD.

Conclusion

We were able to demonstrate a strong relationship between COPD and diminished cognitive status. We were not able to demonstrate any effect of

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gender, race, as well as sociodemographic or vascular risk factors on this relationship between COPD and cognitive status. The independent relationship between COPD and cognitive status may provide us an important clue into the pathophysiology of dementia, which needs to be further explored.

Declaration of Interest

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Table 1. Baseline characteristics by COPD status in the NHANES III population

Characteristics	COPD	No COPD	P Value*
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N	17, 134, 886	22, 294, 015	
Age, mean [SD]	71. 5[0. 2]	69. 6[0. 2]	<0. 0001
Ethnic group, %			0. 0382
Non-Hispanic White	85. 9	83. 3	
Non-Hispanic Black	7. 8	8. 7	
Mexican-American	1. 7	2. 7	
Other	4. 6	5. 3	
Sex, %			<0. 0001
Male	49. 9	37. 7	
Female	50. 1	62. 3	
Education, %			0. 1908
<12	43. 8	40. 3	
12	30. 8	29. 4	
12 and more	26. 9	28. 9	

Poverty income ratio	2. 8 [0. 1]	3. 0 [0. 1]	0. 0077
Body Mass Index, mean [SD]	26. 2 [0. 2]	27. 5 [0. 1]	<0. 0001
Height, mean [SD]	165. 6 [0. 3]	164. 1 [0. 2]	0. 0001
Type of Medicare Coverage, %			
Hospital Only	11. 2	9. 3	0. 3776
Medical only	1. 7	1. 7	
Both	87. 1	89. 0	
Smoking Status, %			<0. 0001
Smoker	21. 4	10. 8	
Non-smoker	78. 6	89. 2	
Cognitive Tests, %			
Serial Subtraction			0. 0075
Impaired	8. 9	6. 3	

Not impaired	91.1	93.7	
Delayed recall			<0.0001
Low	22.2	11.2	
High	77.8	88.8	
Immediate Recall			<0.0001
Low	22.0	11.5	
High	77.9	88.5	
Comorbidities			
Congestive heart failure	8.0	6.5	0.1127
Hypertension	5.9	6.6	0.4195
Diabetes	12.5	12.9	0.7128
Coronary artery disease	31.9	30.4	0.6178
Stroke	7.1	6.3	0.3984

* p values derived from t test comparison of means of COPD by population characteristics

SD = Standard deviation

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Table 2: Crude and adjusted odds ratio for COPD and cognitive tests among 17, 134, 886 individuals in the NHANES III population

Cognitive tests	Crude	Model 1 (OR, 95% CI	Model 2 (OR, 95% CI	Model 3 (OR, 95% CI	Model 4 (OR, 95% CI
Immediate recall					
High (ref)	1	1	1	1	1
Low	2.18 (1.81-2.62)	2.01 (1.65-2.45)	1.92 (1.56-2.36)	1.70 (1.29-2.24)	2.56 (1.95-3.35)
Delayed recall					
High (ref)	1	1	1	1	1
Low	2.25 (1.87-2.70)	2.09 (1.72-2.54)	1.98 (1.61-2.43)	1.80 (1.36-2.36)	3.10 (2.31-4.17)
Serial Subtraction					
Not Impaired (ref)	1	1	1	1	1
Impaired	1.44 (1.10-1.88)	1.26 (0.95-1.67)	1.24 (0.92-1.66)	1.05 (0.69-1.60)	2.74 (1.95-3.87)

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OR = odds ratio, CI = confidence interval, ref = reference

Model 1: adjusted for age and race

Model 2: adjusted for age, sex, height, BMI and education

Model 3: Model 2 additionally controlled for poverty income ratio, race, and medical coverage

Model 4: Model 3 additionally adjusted for stroke, coronary heart disease, hypertension, congestive heart failure, diabetes.

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